	Carbon Dioxide (CO_2) (9/30/65)		Carbon Monoxide (CO) (9/30/65)		Water (H_2O) (3/31/61)		Nitrogen, Diatomic (N_2) (9/30/65)		Oxygen, Diatomic (O_2) (9/30/65)		Hydrogen, Diatomic (H_2) (3/31/61)		
	$(\bar{h}_f^\circ)_{298} = -393\ 522$ kJ/kmol $M = 44.01$		$(\bar{h}_f^\circ)_{298} = -110\ 529$ kJ/kmol $M = 28.01$		$(\bar{h}_f^\circ)_{298} = -241\ 827$ kJ/kmol $M = 18.015$		$(\bar{h}_f^\circ)_{298} = 0$ kJ/kmol $M = 28.013$		$(\bar{h}_f^\circ)_{298} = 0$ kJ/kmol $M = 31.999$		$(\bar{h}_f^\circ)_{298} = 0$ kJ/kmol $M = 2.016$		
Temp. K	$(\bar{h}^\circ - \bar{h}^\circ_{298})$ kJ/kmol	$\bar{s}^\circ$ kJ/kmol K	$(\bar{h}^\circ - \bar{h}^\circ_{298})$ kJ/kmol	$\bar{s}^\circ$ kJ/kmol K	$(\bar{h}^\circ - \bar{h}^\circ_{298})$ kJ/kmol	$\bar{s}^\circ$ kJ/kmol K	$(\bar{h}^\circ - \bar{h}^\circ_{298})$ kJ/kmol	$\bar{s}^\circ$ kJ/kmol K	$(\bar{h}^\circ - \bar{h}^\circ_{298})$ kJ/kmol	$\bar{s}^\circ$ kJ/kmol K	$(\bar{h}^\circ - \bar{h}^\circ_{298})$ kJ/kmol	$\bar{s}^\circ$ kJ/kmol K	Temp. K
0	−9 364	0	−8 669	0	−9 904	0	−8 669	0	−8 682	0	−8 468	0	0
100	−6 456	179.109	−5 770	165.850	−6 615	152.390	−5 770	159.813	−5 778	173.306	−5 293	102.145	100
200	−3 414	199.975	−2 858	186.025	−3 280	175.486	−2 858	179.988	−2 866	193.486	−2 770	119.437	200
298	0	213.795	0	197.653	0	188.833	0	191.611	0	205.142	0	130.684	298
300	67	214.025	54	197.833	63	189.038	54	191.791	54	205.322	54	130.864	300
400	4 008	225.334	2 975	206.234	3 452	198.783	2 971	200.180	3 029	213.874	2 958	139.215	400
500	8 314	234.924	5 929	212.828	6 920	206.523	5 912	206.740	6 088	220.698	5 883	145.738	500
600	12 916	243.309	8 941	218.313	10 498	213.037	8 891	212.175	9 247	226.455	8 812	151.077	600
700	17 761	250.773	12 021	223.062	14 184	218.719	11 937	216.866	12 502	231.272	11 749	155.608	700
800	22 815	257.517	15 175	227.271	17 991	223.803	15 046	221.016	15 841	235.924	14 703	159.549	800
900	28 041	263.668	18 397	231.066	21 924	228.430	18 221	224.757	19 246	239.936	17 682	163.060	900
1000	33 405	269.325	21 686	234.531	25 978	232.706	21 460	228.167	22 707	243.585	20 686	166.223	1000
1100	38 894	274.555	25 033	237.719	30 167	236.694	24 757	231.309	26 217	246.928	23 723	169.118	1100
1200	44 484	279.417	28 426	240.673	34 476	240.443	28 108	234.225	29 765	250.016	26 794	171.792	1200
1300	50 158	283.956	31 865	243.426	38 903	243.986	31 501	236.941	33 351	252.886	29 907	174.281	1300
1400	55 907	288.216	35 338	245.999	43 447	247.350	34 936	239.484	36 966	255.564	33 062	176.620	1400
1500	61 714	292.224	38 848	248.421	48 095	250.560	38 405	241.878	40 610	258.078	36 267	178.833	1500
1600	67 580	296.010	42 384	250.702	52 844	253.622	41 903	244.137	44 279	260.446	39 522	180.929	1600
1700	73 492	299.592	45 940	252.861	57 685	256.559	45 430	246.275	47 970	262.685	42 815	182.929	1700
1800	79 442	302.993	49 522	254.907	62 609	259.371	48 982	248.304	51 689	264.810	46 150	184.833	1800
1900	85 429	306.232	53 124	256.852	67 613	262.078	52 551	250.237	55 434	266.835	49 522	186.657	1900
2000	91 450	309.320	56 739	258.710	72 689	264.681	56 141	252.078	59 199	268.764	52 932	188.406	2000
2100	97 500	312.269	60 375	260.480	77 831	267.191	59 748	253.836	62 986	270.613	56 379	190.088	2100
2200	103 575	315.098	64 019	262.174	83 036	269.609	63 371	255.522	66 802	272.387	59 860	191.707	2200
2300	109 671	317.805	67 676	263.802	88 295	271.948	67 007	257.137	70 634	274.090	63 371	193.268	2300
2400	115 788	320.411	71 346	265.362	93 604	274.207	70 651	258.689	74 492	275.735	66 915	194.778	2400
2500	121 926	322.918	75 023	266.865	98 964	276.396	74 312	260.183	78 375	277.316	70 492	196.234	2500
2600	128 085	325.332	78 714	268.312	104 370	278.517	77 973	261.622	82 274	278.848	74 090	197.649	2600
2700	134 256	327.658	82 408	269.705	109 813	280.571	81 659	263.011	86 199	280.329	77 718	199.017	2700
2800	140 444	329.909	86 115	271.053	115 294	282.563	85 345	264.350	90 144	281.764	81 370	200.343	2800
2900	146 645	332.085	89 826	272.358	120 813	284.500	89 036	265.647	94 111	283.157	85 044	201.636	2900
3000	152 862	334.193	93 542	273.618	126 361	286.383	92 738	266.902	98 098	284.508	88 743	202.887	3000
3200	165 331	338.218	100 998	276.023	137 553	289.994	100 161	269.295	106 127	287.098	96 199	205.293	3200
3400	177 849	342.013	108 479	278.291	148 854	293.416	107 608	271.555	114 232	289.554	103 738	207.577	3400
3600	190 405	345.599	11[illegible] 976	280.433	160 247	296.676	115 081	273.689	122 399	291.889	111 361	209.757	3600
3800	202 999	349.005	123 495	282.467	171 724	299.776	122 570	275.714	130 629	294.115	119 064	211.841	3800
4000	215 635	352.243	131 026	284.396	183 280	302.742	130 076	277.638	138 913	296.236	126 846	213.837	4000
4200	228 304	355.335	138 578	286.241	194 903	305.575	137 603	279.475	147 248	298.270	134 700	215.753	4200
4400	241 003	358.289	146 147	287.998	206 585	308.295	145 143	281.228	155 628	300.219	142 624	217.594	4400
4600	253 734	361.122	153 724	289.684	218 325	310.901	152 699	282.910	164 046	302.094	150 620	219.372	4600
4800	266 500	363.837	161 322	291.299	230 120	313.412	160 272	284.521	172 502	303.893	158 682	221.087	4800
5000	279 295	366.448	168 929	292.851	241 957	315.830	167 858	286.069	180 987	305.621	166 808	222.744	5000
5200	292 123	368.963	176 548	294.349	253 839	318.160	175 456	287.559	189 502	307.290	174 996	224.351	5200
5400	304 984	371.389	184 184	295.789	265 768	320.407	183 071	288.994	198 037	308.901	183 247	225.907	5400
5600	317 884	373.736	191 832	297.178	277 738	322.587	190 703	290.383	206 593	310.458	191 556	227.418	5600
5800	330 821	376.004	199 489	298.521	289 746	324.692	198 347	291.726	215 166	311.964	199 924	228.886	5800
6000	343 791	378.205	207 162	299.822	301 796	326.733	206 008	293.023	223 756	313.420	208 346	230.313	6000

Tabla A.23. Valores a 25 °C y 1 atm de la entalpía de formación, de la función de Gibbs de formación, de la entropía absoluta y de la entalpía de vaporización

($\Delta\bar{h}_f^\circ$, $\Delta\bar{g}_f^\circ$, y $\bar{h}_{fg}$ en kJ/kmol; $\bar{s}^\circ$ en kJ/(kmol · K); el estado estándar es 1 atm)

Sustancia	Fórmula	$\Delta\bar{h}_f^\circ$	$\Delta\bar{g}_f^\circ$	$\bar{s}^\circ$	$\bar{h}_{fg}$
Carbono	$C(s)$	0	0	5,74	
Hidrógeno	$H_2(g)$	0	0	130,57	
Nitrógeno	$N_2(g)$	0	0	191,50	
Oxígeno	$O_2(g)$	0	0	205,04	
Monóxido de carbono	$CO(g)$	−110.530	−137.150	197,56	
Dióxido de carbono	$CO_2(g)$	−393.520	−394.380	213,67	
Agua	$H_2O(g)$	−241.820	−228.590	188,72	
Agua	$H_2O(l)$	−285.830	−237.180	69,95	44.010
Peróxido de hidrógeno	$H_2O_2(g)$	−136.310	−105.600	232,63	61.090
Amoníaco	$NH_3(g)$	−46.190	−16.590	192,33	
Oxígeno	$O(g)$	249.170	231.170	160,95	
Hidrógeno	$H(g)$	218.000	203.290	114,61	
Nitrógeno	$N(g)$	472.680	455.510	153,19	
Hidroxilo	$OH(g)$	39.040	34.280	183,75	
Metano	$CH_4(g)$	−74.850	−50.790	186,16	
Acetileno (Etino)	$C_2H_2(g)$	226.730	209.170	200,85	
Etileno (Eteno)	$C_2H_4(g)$	52.280	68.120	219,83	
Etano	$C_2H_6(g)$	−84.680	−32.890	229,49	
Propileno (Propeno)	$C_3H_6(g)$	20.410	62.720	266,94	
Propano	$C_3H_8(g)$	−103.850	−23.490	269,91	15.060
n-Butano	$C_4H_{10}(g)$	−126.150	−15.170	310,03	21.060
n-Pentano	$C_5H_{12}(g)$	−146.440	−8.200	348,40	31.410
n-Octano	$C_8H_{18}(g)$	−208.450	17.320	463,67	41.460
n-Octano	$C_8H_{18}(l)$	−249.910	6.610	360,79	
Benceno	$C_6H_6(g)$	82.930	129.660	269,20	33.830
Alcohol metílico	$CH_3OH(g)$	−200.890	−162.140	239,70	37.900
Alcohol metílico	$CH_3OH(l)$	−238.810	−166.290	126,80	
Alcohol etílico	$C_2H_5OH(g)$	−235.310	−168.570	282,59	42.340
Alcohol etílico	$C_2H_5OH(l)$	−277.690	−174.890	160,70	
Mercurio	$Hg(l)$	0	0	77,24	
Óxido de mercurio	$HgO(c)$	−90.210	−58.400	70,45	
Manganeso	$Mn(c)$	0	0	31,8	
Dióxido de manganeso	$MnO_2(c)$	−520.030	−465.180	53,14	
Trióxido de manganeso	$Mn_2O_3(c)$	−958.970	−881.150	110,5	
Plomo	$Pb(c)$	0	0	64,81	
Óxido de plomo	$PbO_2(c)$	−277.400	−217.360	68,6	
Sulfato de plomo	$PbSO_4(c)$	−919.940	−813.200	148,57	
Zinc	$Zn(c)$	0	0	41,63	
Óxido de zinc	$ZnO(c)$	−343.280	−318.320	43,64	
Ácido sulfúrico	$H_2SO_4(l)$	−813.990	−690.100	156,90	
Ácido sulfúrico	(ag, m = 1)	−909.270	−744.630	20,1	
Óxido de plata	$Ag_2O(c)$	−31.050	−11.200	121,7	

FUENTES: De JANAF Thermochemical Tables, Dow Chemical Co., 1971; *Selected Values of Chemical Thermodynamic Properties*, NBS Technical Note 270-3, 1968; y *API Research Project* 44, Carnegie Press, 1953.

Enthalpy of Combustion of Some Hydrocarbons at 25°C

Hyrocarbon	Formula	Liquid H_2O in Products (Negative of Higher Heating Value)		Vapor H_2O in Products (Negative of Lower Heating Value)	
		Liquid Hydrocarbon, kJ/kg fuel	Gaseous Hydrocarbon, kJ/kg fuel	Liquid Hydrocarbon, kJ/kg fuel	Gaseous Hydrocarbon, kJ/kg fuel
Paraffin Family					
Methane	CH_4		−55 496		−50 010
Ethane	C_2H_6		−51 875		−47 484
Propane	C_3H_8	−49 975	−50 345	−45 983	−46 353
Butane	C_4H_{10}	−49 130	−49 500	−45 344	−45 714
Pentane	C_5H_{12}	−48 643	−49 011	−44 983	−45 351
Hexane	C_6H_{14}	−48 308	−48 676	−44 733	−45 101
Heptane	C_7H_{16}	−48 071	−48 436	−44 557	−44 922
Octane	C_8H_{18}	−47 893	−48 256	−44 425	−44 788
Decane	$C_{10}H_{22}$	−47 641	−48 000	−44 239	−44 598
Dodecane	$C_{12}H_{26}$	−47 470	−47 828	−44 109	−44 467
Olefin Family					
Ethene	C_2H_4		−50 296		−47 158
Propene	C_3H_6		−48 917		−45 780
Butene	C_4H_8		−48 453		−45 316
Pentene	C_5H_{10}		−48 134		−44 996
Hexene	C_6H_{12}		−47 937		−44 800
Heptene	C_7H_{14}		−47 800		−44 662
Octene	C_8H_{16}		−47 693		−44 556
Nonene	C_9H_{18}		−47 612		−44 475
Decene	$C_{10}H_{20}$		−47 547		−44 410
Alkylbenzene Family					
Benzene	C_6H_6	−41 831	−42 266	−40 141	−40 576
Methylbenzene	C_7H_8	−42 437	−42 847	−40 527	−40 937
Ethylbenzene	C_8H_{10}	−42 997	−43 395	−40 924	−41 322
Propylbenzene	C_9H_{12}	−43 416	−43 800	−41 219	−41 603
Butylbenzene	$C_{10}H_{14}$	−43 748	−44 123	−41 453	−41 828